Changes in camera elevation dictate perceived facing direction of depth-ambiguous biological motion stimuli

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Introduction

Orthographically projected walker stimuli are depth ambiguous and lead to either of two equally valid percepts, facing towards or away from the viewer. Yet, we observe a preference for the facing toward orientation, known as the facing-the-viewer bias (Vanrie et al., 2004).

Induced linear perspective through field-of-view changes has been argued to drive changes in the facing-the-viewer bias (Vanrie et al., 2004; Schouten et al., 2010; Schouten et al., 2013).

We hypothesised that linear perspective is not useful for disambiguating facing orientation perception, but that the useful factor is camera elevation coupled with a viewing-from above bias, and the salience of the feet (see Figure 1). This possibility might previously have been overlooked, given that increases in field-of-view at fixed camera positions is confounded with camera elevation.

If camera elevation with respect to the feet of the walker plays the critical role for perceived facing direction, we will observe a strong effect of camera where negative camera elevations will produce facing away perceptions.

Psychometric functions produced by this method should be similar to those induced by direct field-of-view manipulations.

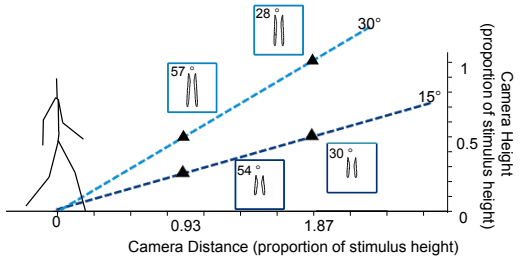

Figure 1: The elevation at which a rendering camera is positioned has a greater incidence on the projection of the feet movement than the corresponding field-of-view (FOV, indicated within boxes). Traces of the point-light walker's feet are displayed for four camera positions, indicated by the black triangles. Cameras at corresponding elevations result in strikingly similar feet projections, but similar field-of-view values do not.

References

Vanrie, Dekeyser & Verfaillie (2004). *Perception, 33.*
Schouten, & Verfaillie (2010). *Behaviour Research Methods, 42*(1).
Schouten, Davilla & Verfaillie (2013). *PLoS ONE, 8*(2).
Schouten, Troje, van der Zwan, & Verfaillie (2010). *Attention, Perception , & Psychophysics, 72*(5).
Troje, N. F. (2002) .*Journal of Vision, 2.*
Troje, N. F., Kenny, S., & Weech, S. (2013). *CAN-ACN.*

Methods and Procedure

Participants: Thirteen students from Queen's University with no previous exposure to walker stimuli.

Stimuli: Gender-neutral dynamic stick figure walkers generated according to Troje (2002) . Stimuli were presented for 2 s in the middle of a screen, to a constant viewing angle of 3.2°.

Design and Procedure
After each stimulus presentation, we asked:
"Is the figure coming towards you, or going away from you?".
Answers were recorded via key press.

We targeted 25%, 50% and 75% facing the viewer thresholds with a 3:1, 1:1, and 1:3 weighted staircase, with a step size of 2° to obtain the point of subjective equivalence and the slope of the psychometric function relating camera elevation to perceived facing direction.

Camera elevation was manipulated about the horizontal plane, where negative camera elevations effectively view the walker from below. Implications of the method are discussed in Figure 2.

180 randomly interleaved trials were presented (3 staircases * 60 trials).

Facing-the-viewer responses at threshold are computed on the last 10 trials.

Exclusion criterion: Participants were excluded from final analysis if response proportion differed by 10% either 25% , 50% or 75%, on the last 20 trials. This procedure resulted in exclusion of 7 out of the original 20 participants.

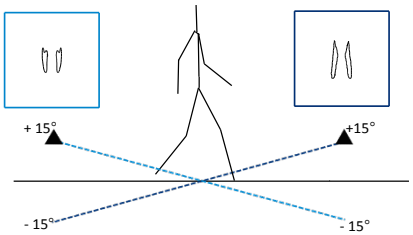

Figure 2. In our method, when a viewing-from above bias is taken into account, negative camera elevations with respect to the feet will results in a facing-away percept.

Results

Camera elevations at the 75%, 50% and 25% threshold were significantly statistically different: $F(2, 22) = 16.04$, $p < .001$;

- *Ms* = -1.00°, -6.27°, and -12.87°; *SDs* = 8.28°, 10.99°, and 10.14°.

Camera elevation was statistically significant between the :

- 25% and 50% thresholds, t(11) = 3.80, p = .003;
- 50% and 75% threshold t(11) = 2.43, p = .033).

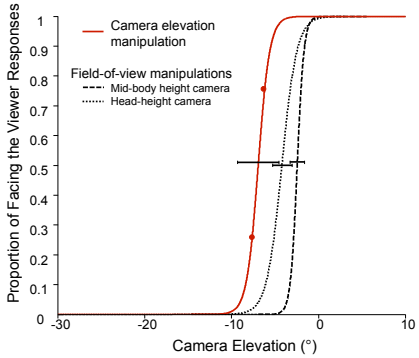

Figure 3. The camera elevation at the 25 and 75% facing the viewer thresholds of the current experiment were used to extrapolate the appropriate psychometric function. Results from the mid- and head-height conditions from Troje, Kenny, and Weech (2013) were recomputed into camera elevation at threshold. *Note.* Error bars represent *SEMs.*

Discussion

The viewing-from-above bias correctly predicted significant effect of camera changes on perceived facing direction, with negative camera elevations resulting in facing-away perceptions. The psychometric function from Experiment 2 is directly comparable to data from experiments using field-of-view manipulations (see Troje, Kenny, & Weech, 2013). Together, these results argue that the effect observed in manipulations of linear perspective can directly be attributed to effects of camera elevation changes in combination with a strong viewing-from-above bias.

Conclusion

Camera elevation changes, not linear perspective, drives changes in perceived facing direction of depth-ambiguous walker stimuli.

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